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ABSTRACT

Within the context of declining enrollment, this paper considers the questions of economies of scale, cost-quality interrelationships, and rigidities in the Ontario school system. From a survey of the pertinent literature, the author concludes that economies of scale are linked to the level, size, and pupil/teacher ratio of a school and operate only under certain conditions. The relationship between cost and quality is even less well-defined. The author quotes many researchers who claim that no statistical relationship exists between expenditures and student performance on standardized tests. Similarly, he fails to unearth evidence that demonstrates a correlation between student achievement and a low pupil/teacher ratio. The author concludes that schools will have to be closed and that school boards, through careful planning and well-publicized decision-making, can effect such closures despite the rigidities created by strong bargaining units and the existing affinity for neighborhood schools. (Author/WD)

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ECONOMIES OF SCALE AND COST-QUALITY RELATIONSHIPS IN ELEMENTARY AND SECONDARY SCHOOLS: A SURVEY

D. A. DAWSON

MARCH, 1978

COMMISSION ON DECLINING SCHOOL ENROLMENTS IN ONTARIO (CODE)

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"It is to Judge Wright's credit that he dismissed 'educational production functions' as spurious and the economies of scale argument as specious" - S. Michelson (1976) "For the Plaintiff - Equal School Resource Association" The Journal of Human Resources 7, 306.

"The quality of education cannot be measured" - Advisory Council on Fluctuating School Enrolments (1977) The Impact of Fluctuating School Enrolments on Minnesota's Educational System (Madison), p. 37.

Introduction and Summary

Despite the sentiments noted in the quotations presented overleaf, it is the aim of this paper to stick relatively closely to the research agenda mapped out for the author by the Commissioner. In particular, the paper will look at three of the areas of concern in a situation where enrolment is declining in the primary and secondary sectors of education in Ontario. These are,

a) the question of economies of scale,
b) the question of cost-quality interrelationships, and
c) the question of rigidities which might arise in a system reacting to declining enrolments.

Due to time constraints (imposed but not always adhered to) the survey is not encyclopaedic. Hopefully, however, the results of current research in these areas are presented in a meaningful fashion, despite the level of generalization.

These areas are of critical importance for two reasons. First, if data relating to economies of scale, particularly to economies of scale at the school level, indicate a minimum efficient scale[1] of school operation then, as enrolments decline in certain school areas and fall below the minimum efficient scale of operation, school closings would be indicated. Second, as schools are closed, teachers in these schools will become redundant unless they are transferred to other schools in the system where enrolments are either increasing or holding their own or perhaps even declining but not as yet to the minimum efficient scale.

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[1] The minimum efficient scale is the point at which the average cost curve first reaches its minimum point. Accordingly, if the scale of operation of a school, in terms of enrolment, is below this point, average costs rise (at varying rates).

To support a policy of teacher transfer, particularly in the latter two cases, one would have to argue that the teacher/pupil ratio is positively related to educational quality. Only if this can be proven can a decision to not decrease the teacher salary bill by teacher attrition be rationalized.

The reports considered in this study concentrate on the scale economies and cost-quality questions. They indicate that, in the case of economies of scale, there is evidence indicating the existence of a minimum efficient scale at the school level particularly as it relates to the Province of Ontario. Therefore school closings are, in fact, economically (but perhaps not politically) viable. On the question of teacher/pupil ratios this study concludes that there is no clear evidence to support the contention that quality goes up as teacher/pupil ratios rise. In addition, there is a finding that even if one were to adopt this route it is a very expensive course of action to follow.

The question of rigidities is dealt with very briefly. The general conclusion is that freedom of information, coupled with good research, is a sine qua non if one is to provide the province with adequate malleability in the educational process.

Economies of Scale

Economies of scale exist when the average total cost of producing a product declines as output increases. Diseconomies of scale exist when average total cost increases when output increases. Constant returns to scale imply constant average total costs regardless of the level of output.

There is a relatively large literature concerning the study of scale economies in the primary and secondary sectors of the economy. However, the study of economies of scale in public service

industries is a scholarly activity of relatively recent origin. In the case of education, in particular, it was less than two decades ago that Hirsch did some of the original work in economies of scale (Hirsch, 1962). Before analyzing the available data it would probably be worthwhile to briefly discuss the methodology normally used to study economies of scale in the educational system.

To put scale studies in perspective one should think of a schooling system as an industry. One can think of school boards as companies which run schools (plants), hopefully in an efficient fashion. Complicating the situation is the fact that the schools are not homogeneous: some of the schools produce secondary students and some produce elementary students.[2] The capital-output ratios for producing these different types of students are indeed different. Even within the secondary schools there is, in many cases, product differentiation in that the schools can produce arts and science students or commercial and vocational students and these, in turn, require different capital-output ratios.

Given that it is possible to delineate the different types of boards (companies) and schools (plants) the first problem one must address is the definition of the relevant costs that we need to measure to ascertain whether or not economies of scale exist. Costs relevant to education can be divided into two general categories:

a) direct costs of education, and
b) indirect costs of education.

The main sources of direct cost are operational expenditures, such as teacher salaries, plant operation expenses, etc. It is

[2] Nor are there established relative values (market prices) for their different outputs.

generally agreed that these types of costs should be included in a summation of the economic costs of education. However, what is not generally agreed upon is whether to include expenditures on items such as transportation. With regard to this cost, Riew (1964) notes that "the per pupil costs of transportation often vary more with population density, and the distance the school bus has to travel than with the size of school which may or may not reflect population density," (p. 283).

Other costs which undoubtedly should be included in the summation of the economic costs of education are capital outlays, debt service and depreciation. However, in many cases, it has proven difficult to estimate these costs and researchers interested in the field often have to make rather heroic assumptions about depreciation rates.

Finally, it should be noted that since the schools or school boards use police services, library services, fire services, etc. they should probably be paying some type of property tax. In most of the studies noted there is no allowance for an imputation of the magnitude of this type of expenditure.

The indirect costs of education are the opportunity costs of students who are in the system at any given time, i.e. what could a student be earning if he or she were not in school. A person trying to estimate these costs would face a number of problems, such as:

a) can the wages of dropouts be taken as proxies for the opportunity costs of students still in school or would these students actually be worth more because of accumulated human capital?

b) should we take into consideration the fact that if all school children entered the labour market the

marginal productivity and therefore opportunity costs would decline?

c) should we consider the possibility that an employment vacancy might not be available - a condition which would cause opportunity costs to be zero?

Given these problems and given that over any particular school jurisdiction, be it a state or province, the opportunity costs for students will not vary a great deal, researchers normally ignore this particular component of cost.

Once the cost of education for any particular time period or series of time periods has been estimated,[3] the next question the researcher must face is the definition of the output of a particular board or school. In most studies it is assumed that average daily attendance (ADA) is a relatively good measure of output. However, the use of these raw data ignores the fact that there are undoubtedly differences in the quality of schooling provided by different boards or schools. Accordingly, one should attempt to account for these differences in quality.

There are three basic ways in which attempts to measure quality can be carried out. First of all, one can use process measures. This procedure assumes that if high quality factors of production are used in the production process of students, i.e., highly trained teachers, experienced teachers, etc., then a high quality product will ensue. One might also use a product measure. Such a measure could be a standardized test score or a series of standardized test scores. Finally, and most expensively, one can measure quality of output by using subjective measures of the

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[3] Cost curves can be estimated using time series on cross-section data.

quality of education. Construction of these measures is expensive because of the number of interviewers needed to collect the necessary data. A good summary of the problems with measuring educational quality can be found in Dancey and Dawson (1973, Appendix B).

Rather than analyzing in great detail all of the past studies of economies of scale in education, particularly with regard to their approaches to dealing with the problems noted above, we have appended as Annex A an annotated bibliography of the relevant studies which have been found during the process of research for this paper. In general, these studies are divided into studies of school boards (companies) and schools (plants) in various jurisdictions. Unfortunately, most fail to allow for differences in school quality.

Generally, the results of the studies indicate that at the board level there appears to be evidence of economies of scale up to a point. At the school level the evidence is much stronger in support of the existence of economies of scale. Conversely, and more importantly for the purposes of this paper, it should be noted that this implies that as schools become smaller there are increases in average cost when enrolment declines past the minimum efficient scale.

Two relatively recent studies of economies of scale have been carried out relating directly to the Ontario case. These studies are Dawson (1969) and Dawson and Dancey (1974). The first of these studies is concerned with the preconsolidation structure of primary and secondary education in Ontario. The year studied is 1964. Since a very large number of elementary school boards existed at the time, the study deals only with economies of scale in the secondary school education sector. Because of the existence of the

large number of school boards each operating only one secondary school, it was possible to measure for economies of scale in schools as well as in school boards.[4]

In an effort to standardize for school quality the author constructs two educational quality indices. The first estimates school quality by the quality of students produced. This index is constructed using the results of tests administered by the Ontario College of Education over a four-year period. (Thus it does avoid some of the problems created by one year quality measurements dealt with in the cost-quality section noted below.) The second index measures school quality by the quality of the factors of production in each school such as teacher experience, teacher qualifications, etc. When these measures are applied in a multiplicative manner to raw ADA, "quality adjusted" output results.

The results of the study indicate that when one looks at single school boards (a proxy for schools) the data generally indicate the existence of either continuing economies of scale or constant returns to scale. When all school boards are investigated, however, the results are not so clear-cut. In this case when the output of the school is measured by raw attendance data or the raw data weighted by the product quality index a rotated L-shaped cost curve (⌒) is found for academic programs and a "Lazy S" - average cost curve (∽) for commercial/vocational programs. When the input quality measure is applied to output the result is increasing returns to scale in the academic case and a "Lazy S" - average cost curve in the commercial and vocational case.

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[4]This existence of single school boards was necessary for the measurement of school economies because multi-school boards do not publish operating data by school.

The second study deals with Ontario in the post-consolidation period. In particular, the authors analyze 1970 data at both the elementary and secondary levels. Unfortunately, data limitations made the measurement for economies of scale in schools unfeasible. As was the case in the previous study this study attempts to allow for school quality. In this case quality is measured by the achievement of pupils in various schools and school boards on the tests administered by the Service for Admission to College and University (SACU). The details of the construction of the quality index are noted in Dawson and Dancey (1973, p. 187). In summary, their method is to rate each school in accordance with the school's average score compared to the Ontario average on the three tests administered. The resulting product index is then applied to school board output to give a quality weighted school board output. As noted in Annex A the results of this study indicate that at the secondary school board level there are economies of scale up to a size of 4,000 pupils but beyond this point the results differ depending upon whether the raw or quality-adjusted enrolment data are used. The raw data results indicate some diseconomies beyond this point but the quality adjusted data show constant returns to scale after this point. At the elementary level the study finds no continuing economies of scale.

This study goes further than the previous one in that an attempt is made to analyze the components of costs and not just the total costs themselves. Details of the behaviour pattern of costs over different levels of enrolment can be found in Dancey and Dawson (1974). However, it might be worthwhile to summarize the results here.

Salary cost data were available for secondary schools only. The results of the analysis of this variable indicate that variations in the pupil/teacher ratio account for much of the variation

in salary costs per pupil. Whether or not the pupil/teacher ratio is included in an explanatory equation, it appears that the salary costs per pupil follow a "U-shaped" pattern. Depending upon different estimating methods used, the minimum point of the U occurs at either 1,050 pupils or 1,900 pupils. In the former case the reduction in average costs per pupil between 100 and 1,050 pupils is only $6 per pupil. In the second case the saving is $130 per pupil. When the raw data are weighted by quality, U-shaped cost curves are once again in evidence. The minimum portion of the cost curve appears to be in the 1,000 to 1,200 student area with saving of about $26 to $70 per pupil as school size is increased to the minimum efficient scale.

When the focus shifts from salary cost to instructional costs at the secondary level (which include the costs of administrators and clerical and secretarial staff as well as instructors) one has to use board data since these data are not available at the school level. To summarize the results in this case it appears that there are economies of scale (in instructional costs) at the board level, up to a board size of 4,000 pupils using both weighted and unweighted data. When one uses weighted costs the decline in cost is more pronounced and any eventual increase is relatively negligible. Analysis of the data also indicates that the pupil/teacher ratio is very expensive to lower.

When one analyzes instructional costs at the elementary board level only raw enrolment data can be analyzed since the SACU tests are given only in Grade 13. In this case analysis of the results indicates that there are no economies of scale in instructional costs. The pupil/teacher ratio is, as it was for the secondary level, the main explanatory variable, but the size of the coefficient is lower and indicates that the cost of changing the

teacher/pupil ratio by one pupil is $13 to $15 which is about one-third the size of the coefficient at the secondary level.

Plant operation and maintenance costs at the secondary level exhibit the following characteristics:

a) plant maintenance costs appear to have no relation with either the size of the school or the size of the school board,

b) plant operation costs decline with school size up to 1,300 students.

Beyond this point the empirical evidence is contradictory and depends upon which alternative econometric formulations one uses. It appears that even if economies did exist beyond this size the savings would probably be negligible. At the school board level there is no statistical evidence that plant operation costs decrease as board size is increased.

At the elementary board level there do not appear to be any significant economies of scale in plant maintenance and operation costs. When one makes some estimates of cost curves at the school level for elementary boards the indications are that there may be some cost savings in plant operation in larger schools. However because of data limitations only an indirect approach could be used in estimating school economies and enrolment coefficients were not significant.

Finally, in the case of business administration costs at the secondary level it appears that there are substantial economies of scale. However, beyond the board size of 4,000 to 6,000 pupils the economies are minimal. It should be noted that, although there are economies of scale in administration expense, in this survey this expense amounted to only about 2.5% of ordinary operating

expenditure.

The existence of economies also appears in business administration costs at the elementary board level. However these economies are substantially less than those which are found at the secondary board level.[5]

Cost and Quality Considerations

If the reader was left with a lack of complete satisfaction with the comprehensiveness and consistency of the results presented in the previous section, then this section will probably prove to be even more dissatisfying. The cost-quality debate has waxed for years and thus far there is no general consensus as to the general direction of the cost-quality interaction. Before analyzing this particular problem it should be noted that an annotated bibliography of relevant work has not been presented, as it was for the previous section, because of the vast amount of literature in this area of concern. If one would like to make a survey of some recent work, however, the Minnesota study does present a short annotated bibliography in Chapter X. (Advisory Council on Fluctuating School Enrolment, 1977.)

As noted in the McDermott, Klein (1974) paper, a number of well-known social scientists including such people as Coleman and Jencks claim that "beyond some minimum per pupil expenditure level, statistical relationships between dollars spent per pupil and student performance on standardized tests do not exist. To put

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[5] Before leaving this subject note should be made of a recent study carried out by Rideout et al. (1977). Amongst other things, the authors analyze efficient size of schools at the elementary level using the questionnaire method. Their finding is that only when the enrolment of an elementary school drops below 300 students can one expect sharply rising costs.

it another way, higher expenditures do not produce higher student achievement." (p. 415) It is the general conclusion of these investigators that socioeconomic factors such as home background account for most variation in pupil achievement.

Before assessing these conclusions it might be wise to note some of the problems involved in carrying out statistical analysis of the impact of cost in quality. First, most of the measures of pupil performance are based upon standardized achievement tests, i.e., the "cognitive academic domain is the only area tested" (McDermott and Klein, 1974, p. 424). In addition to this, other problems arise when using standardized scores:

a) the test upon which the scores are based may be measuring the effectiveness of programs which are not the programs which are being pursued by some schools,

b) there have been some claims that poor test design exists in some of the standardized tests,

c) it is not clear whether tests measure what they state that they are measuring. For example, "reading test may be measuring skills other than reading, such as reasoning or general intellectual ability" (McDermott and Klein, 1974, p. 425).

A second general problem in cost-quality studies is the fact that the expenditures measured often relate to total programs within a school or school district whereas the standardized test scores measure only the output of one particular aspect of the educational process, be it reading or mathematics.

On another level, a number of caveats have been stated concerning the methodology used in analyzing test scores, be it

correlation analysis or multiple regression analysis. The methodological problems arising, such as that of multicollinearity,[6] have been stated by a number of critics.

Finally, a majority of the tests involve cross-section rather than time-series analysis. Implicitly, then, the tests claim that any previous educational activities really have no effect upon the output measured at one particular point in time. It is only the activities carried on in the academic year in which the tests are made which have any effect. One way around this problem is to look at student performance from a longitudinal point of view and measure incremental achievement outputs over time. Examples of cases where this has been done can be found in Dawson (1969) and Summers and Wolfe (1977).

Having noted the existence of methodological problems let us first look generally at the results of past cost-quality studies and then look at one particular component of the cost-quality question, that of class-size or pupil/teacher ratio. The study which has probably stimulated most research comment and controversy in recent years is that published by James S. Coleman in 1966. His sample size was 645,000 students from 3,500 schools throughout the United States. The measure of achievement used by Coleman was students' performance on a standardized verbal achievement test. Other data on students were obtained from various sources such as principals, school superintendents and the students themselves. The three major conclusions of the Coleman study were as follows (Winkler, 1972, 1973, p. 13):

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[6]This occurs where a linear relationship between two independent variables may cause one of the coefficients to be insignificant.

a) school facilities and curriculum do not significantly contribute to variations in student achievement,

b) while no school factors account for much variation in achievement, teacher characteristics, e.g., verbal ability, account for more variation than do others,

c) the social composition of a student body is more highly related to achievement than is any other factor.

The Coleman data have been extensively reinvestigated by individuals such as Jencks and Bowles. In general, the re-evaluations of the study have tended to produce changes in the size of effect rather than in changes in sign per se.

A summary of the results of some other studies in the area compiled by the Wisconsin Advisory Committee is appended as Annex B. It generally indicates that there is no consistent correlation between cost and quality.

Before moving on to the more specific question of pupil/teacher ratio, note should be made of a recent American Economic Review study by Summers and Wolfe (1977). This is unique because, unlike past studies which represented many inputs to the educational process by school or district wide averages, they have used pupil-specific data. In addition, as noted above, although past studies have used achievement level as the output measure, this study uses a value added dependent variable - the change in achievement over a period of years. The authors have used the pupil-specific approach because they feel that "the use of school district averages introduced so much noise as proxies for inputs into

students that effective inputs were not revealed" (p. 640). The study is based upon a 1970-71 pupil data file for 627 sixth grade elementary school students in 103 elementary schools. The results for class size variables will be noted below. The authors conclude,

> "1. that many school inputs do matter,
>
> 2. that disadvantaged students can be helped by particular types of inputs, and
>
> 3. that the use of pupil specific data, and statistical methods appropriate to such data, account for the cheerier results of the study." (p. 639)

In Ontario an extensive effort was made to measure cost-quality variables in the early 1970's by Dancey and Dawson (1973). Because of their inability to obtain a quality index at the elementary level they focused on cost-quality in secondary education. The quality variable analyzed was ths SACU board measure described above and the various process elements were: (a) average experience of teachers, (b) percentage of teachers with five years or more of teaching experience, (c) percentage of teachers with two years or more teaching experience, (d) the percentage of teachers with level 3 and 4 certificates, (e) the percentage of classes with 31 or more pupils and (f) the pupil/teacher level. Changing any one of these ratios, ceteris paribus, would naturally alter costs but the question is, would quality also change? Their analysis looks at interaction at both the secondary school and school board level.

The secondary school data were compiled from the OSSTF statistical summary entitled Report of Committee on Conditions of Work

for Quality Teaching and the sample size was 417 schools. It included city, county and district schools.

The simple correlations between the variables for the total sample and for the sub-groups are presented in tables 1-4. The results indicate that the proportion of teachers in certification groups 3 and 4 is positively correlated with the SACU index. On the other hand, as one would expect, the proportion of unqualified teachers is negatively correlated with the index. Average teacher experience is positively correlated with the SACU index in three of the four tables but the correlations are very low and insignificant. Low correlations also exist between the SACU index and average salary and any relation which exists is negative. Another negative (but weak) correlation seems to exist between salary cost per pupil and the SACU index. Contrary to the expectations of many, there is a positive correlation between the pupil/teacher ratio and the SACU index. The strongest positive correlation in the latter case is in the district schools which could indicate that small schools, which tend to be more prevalent in districts, have low pupil/teacher ratios not for quality reasons, but because teachers cannot be efficiently used in smaller schools. Finally, it should be noted that the only variable which seems to be significantly related to the SACU index is the qualifications of teachers.

At the school board level, the data used were provided by the OSSTF for the Fall of 1969 and 1970. These data were weighted to conform to board cost data for the 1970 calendar year. Correlations of the variables measured are presented in tables 5, 6 and 7. Since only four city boards were used the same correlations are not presented for that sub-sample.

Table 1: All Schools (417)-- Cost-Quality Correlations

	Prop. Nil	Avg. Sal.	Avg. Exp.	Avg.Sc. Index	Pup/Tch. Ratio	Prop. 3 & 4	Sal.Cost/ Pupil
Prop. Nil		-.32	-.26	-.25	-.19	-.68	-.01
Avg. Salary			.57	---	.17	.52	.45
Avg. Experience				.05	.18	.26	.18
Avg.Score Index					.09	.27	-.08
Pup/Tch.. Ratio						.35	-.79
Prop 3 & 4							-.01
Sal. Cost/Pup.							

Source: Dancey and Dawson (1973, 213).

Table 2: District Schools (56) -- Cost-Quality Correlations

	Prop. Nil	Avg. Sal.	Avg. Exp.	Avg.Sc. Index	Pup/Tch. Ratio	Prop. 3&4	Sal.Cost/ Pupil
Prop. Nil		-.27	-.52	-.23	-.07	-.69	-.09
Avg. Salary			.53	-.13	-.08	.28	.64
Avg. Experience				.17	.28	.48	.09
Avg. Score Index					.24	.42	-.25
Pup/Tch. Ratio						.37	-.80
Prop 3 & 4							-.13
Sal. Cost/Pup.							

Source: Dancey and Dawson (1973, 213).

Table 3: County Schools (260) -- Cost-Quality Correlations

	Prop. Nil	Avg. Sal.	Avg. Exp.	Avg.Sc. Index	Pup/Tch. Ratio	Prop. 3&4	Sal.Cost/ Pupil
Prop. Nil		-.37	-.25	-.25	-.22	-.68	---
Avg. Salary			.60	.05	.19	.51	.42
Avg. Experience				.03	.14	.21	.22
Avg. Score Index					.07	.27	-.03
Pup/Tch. Ratio						.36	-.80
Prop 3 & 4							-.03
Sal. Cost/Pup.							

Source: Dancey and Dawson (1973, 214).

Table 4: City Schools (99) -- Cost-Quality Correlations

	Prop. Nil	Avg. Sal.	Avg. Exp.	Avg.Sc. Index	Pup/Tch. Ratio	Prop. 3&4	Sal.Cost/ Pupil
Prop. Nil		-.27	-.01	-.15	-.15	-.80	.02
Avg. Salary			.62	-.10	.33	.50	.26
Avg. Experience				-.13	.21	.17	.16
Avg. Score Index					.02	.14	-.07
Pup/Tch. Ratio						.39	-.81
Prop 3 & 4							-.12
Sal. Cost/Pup.							

Source: Dancey and Dawson (1973, 214).

The results in these tables indicate first that, in general, the positive correlation between the SACU index[7] found at the school level still exists at the board level. However, at the sub-group level the relationship is negative (-.10) for the county boards and positive (.47) for the district boards. Once again this may be a result of the inefficient use of teachers in smaller schools. The remaining variables have, in general, the expected signs. However, rather than giving detailed analysis here the reader is referred to the source study (pp. 206-263) where a comprehensive analysis including regression analysis is presented.

Turning now from general considerations to the specific case of the pupil/teacher ratio, note should first be made of a statement made by Blaug. In his book An Introduction to the Economics of Education he states that "no single generalization could cover all the different situations in which quality sometimes rises and sometimes falls with variations in class size. The point is, however, that "the folklore of the small class," the folklore shared alike by teachers and parents, is precisely the sort of belief that leads to expenditure patterns divorced from all considerations of effective outcomes" (1970, p. 278).

It is this question of the pupil/teacher ratio which is very important for the Commission at the present time. Faced with the spectre of declining enrolments the factors of production most threatened by the situation will naturally seek to find a rationale for maintaining their position in the educational process. If teachers can argue convincingly that the declining enrolments which will result in lower pupil/teacher ratios will produce a

[7] In fact the results for two SACU indexes are displayed here. SACU II allows for the deletion of predominantly French speaking schools.

Table 5: Cost-Quality Correlations-Secondary Boards

Correlations--69 Boards

		26	27	29	30	31	32	33	34	39	43
Prod.Index I	26	1	.976	.187	.509	.429	.518	.517	.082	.291	.506
Prod.Index II	27		1	.179	.494	.412	.496	.496	.076	.268	.474
Avg. Salary	29			1	.370	.453	.437	.398	.082	.110	-.007
Avg. Experience	30				1	.829	.699	.380	.067	.256	.354
Avg. Prop. $\geq$ 5	31					1	.802	.504	.083	.112	.456
Avg. Prop. $\geq$ 2	32						1	.638	.296	.069	.503
Prop.Cert.3&4	33							1	.407	.370	.413
Prop.Classes $\geq$ 31	34								1	.530	.104
Pup/Tch.Ratio	39									1	.085
Assess/Pupil	43										1

Correlations--38 Counties

		26	27	29	30	31	32	33	34	39	43
SACU Index I	26	1	.999	.362	.220	.343	.429	.465	-.021	-.100	.445
SACU Index II	27		1	.369	.219	.343	.430	.467	-.036	-.107	.448
Avg. Salary	29			1	.085	.429	.289	.719	.217	.306	.368
Avg. Experience	30				1	.692	.452	-.119	.047	.061	.204
Avg. Prop. $\geq$ 5	31					1	.702	.178	-.020	.135	.348
Avg. Prop. $\geq$ 2	32						1	.362	-.120	-.134	.400
Prop.Cert.3&4	33							1	.129	.111	.395
Prop.Classes $\geq$ 31	34								1	.725	-.167
Pup/Tch.Ratio	39									1	-.050
Assess/Pupil	43										1

Correlations--27 Districts

		26	27	29	30	31	32	33	34	39	43
SACU Index I	26	1	.950	.250	.560	.300	.434	.314	.025	.472	.381
SACU Index II	27		1	.215	.563	.302	.418	.305	.058	.452	.338
Avg. Salary	29			1	.663	.677	.692	.496	.086	.083	-.131
Avg. Experience	30				1	.804	.650	.344	-.105	.175	.144
Avg. Prop. $\geq$ 5	31					1	.745	.416	-.056	-.081	.280
Avg. Prop. $\geq$ 2	32						1	.589	.325	-.064	.343
Prop.Cert.3&4	33							1	.506	.417	.088
Prop.Classes $\geq$ 31	34								1	.406	.112
Pup/Tch.Ratio	39									1	-.057
Assess/Pupil	43										1

Source: Dancey and Dawson (1973).

higher quality of education, they can further argue that expenditure levels, particularly those involved with teacher ratios will produce a higher quality of education.

As has been our practice above, before looking at some of the empirical results of studies on this question, let us record some of the problems which arise in this area which have consistently led to the failure of studies to confirm or deny the benefits of small-class size. The weaknesses are as follows:

"a) class size has been variously defined and measured,

b) researchers disagree in the perception of small and large,

c) comparability among studies is limited by differences in the dependent variables,

d) educational innovations such as individually guided education, computer assisted instruction, and altered staffing patterns increase the difficulty of determining the impact of class size and may even alter optimum class size needs,

e) there might be a bias in favour of small size because of such things as "atmospheric conditions" such as teacher and pupil morale." (Advisory Council of Fluctuating School Enrolments, p. 167)

A study by Blake (1954) in which he surveys the results of a number of class size investigations indicates that 35 of the studies surveyed found that smaller classes were more effective, 18 found that larger classes were more effective, and 32 were inconclusive. Jencks (1972) found a limited relationship between class size and student achievement. In particular "using 11 year olds as an example, Jencks added that if schools halve their class sizes, thus doubling their costs, achievement would be

accelerated only by a month or two" (Advisory Council on Fluctuating School Enrolments, p. 170). A more positive finding in the class size question is made by Fernal and Collins (1967). Using longitudinal changes in results over the period 1959 to 1964 the authors find the smallest class size grouping produces relatively larger gains in scores. Another interesting result of the study is that the smaller size classes are more effective for non-white students.

The more recent study by Summers and Wolfe (1977), when discussing class size results, states that "low achieving students (those scoring two or more years below grade level) did worse (almost 3 months worse over the 3 years) in classes with more than 28 students; high achieving students (those scoring two or more grades above grade level) did better (almost 3 months better); those around grade level appeared to be unaffected" (p. 645).

In general on the question of pupil/teacher ratio one would have to agree with the President's Commission on School Finance which states that "despite diligent searches and widespread opinion to the contrary, the commission finds no research evidence that demonstrates improved student achievement resulting from decreasing pupil/teacher ratio" (Advisory Committee on Fluctuating School Enrolments, 1977, p. 172).

Finally, it should be noted that even if one were to be convinced by the arguments favouring smaller pupil/teacher ratios there should be cognizance of the cost of changing these ratios. In their study on economies of scale, Dawson and Dancey look at salary costs at the secondary school level using the report by the Ontario Secondary School Teachers' Federation entitled Report of Committee on Conditions of Work for Quality Teaching. They find that the regression results indicate that it would cost

nearly $56 per pupil to reduce the pupil/teacher ratio by one pupil (Dawson and Dancey, 1973, p. 29).

Rigidities

The situation of declining enrolments will necessitate changes in the primary and secondary school systems in Ontario. One of the crucial questions arising is how governing bodies can best deal with this situation given the existence of rigidities created by strong bargaining units and the affinity to historical subdivisions of educational responsibility.

Undoubtedly schools must be closed. In carrying out this act school boards would be wise to follow the advice stated in Rideout et al. (1975, p. 79-90). In particular, school boards should first carry out detailed planning, particularly with respect to such items as enrolment data, costs (particularly on a school-by-school basis), staffing, accommodation and facilities, and programs. Once data are available the boards must carry out a well publicized review concerning possible closure and redundancy. An informed public, however reluctant, might be more rational than one deprived of facts.

Economies of Scale in Education - An Annotated Bibliography

1. Cohn, E. (1968) "Economies of Scale in Oiwa High School Operations" The Journal of Human Resources 3, 422-434.

   Using a sample comprised of 377 high school districts the author attempts to measure cost and output functions. The 1962-63 data do not produce a very satisfactory quality measure. However, when cost functions are estimated, significant economies of scale are in evidence. The optimal school size is approximately 1,500 pupils.

2. Cohn, E. and J. Riew (1974) "Cost Functions in Public Schools" The Journal of Human Resources 10, 408-414.

   In this reply to Michelson (Michelson, 1972) the authors rationalize the different estimates of cost curves in their studies.

3. Dawson, D.A. (1972) "Economies of Scale in the Ontario Public Secondary Schools" Canadian Journal of Economics 5, 306-309.

   This article reports on a cross section study carried out by the author using 1964 data for Ontario. The independent variable (Total Cost) includes the following costs: (a) administrative costs; (b) plant operation and maintenance costs; (c) instructional salaries; (d) instructional supplies; (e) interest on temporary borrowing; (f) long-term interest charges; (g) depreciation; (h) property tax; (i) sales tax. The independent variables are average daily attendance (ADA) and ADA weighted by school quality measures. In the case of schools the results indicate, with one exception, either constant returns to scale or increasing returns to scale. The board data do not produce conclusive results.

4. Dawson, D.A. and K.J. Dancey (1974) "Economies of Scale in the Ontario Public School Sectors" The Alberta Journal of Educational Research 20, 186-197.

   This study (reports on Dancey & Dawson (1973) and updates the work of Dawson (1972) in that it deals with the Ontario case after the consolidations of the school boards which took place in 1969. It deals with both the elemen-

tary and secondary school sectors at the aggregate cost level. The data analysed are for the year 1970.

To allow for differences in the quality of education provided by different school boards the authors construct a "product" quality index using test results obtained from the Service for Admission to College and University (SACU) tests.

At the secondary level the results indicate economies of scale up tc a size of 4,000 pupils. Beyond 4,000 pupils the results differ depending on whether or not raw, or quality adjusted data are used. The raw data results indicate some diseconomies beyond the 4,000 pupil level while the quality adjusted data suggest constant returns to scale.

At the elementary level the authors find little evidence of economies of scale.

5. Ellis, J.W. (1967) An Investigation of the Cost Function for Kansas School Districts, 1965-66 Unpublished M.A. Thesis (Department of Economics, Wichita State University).

In a cross section analysis of 76 Kansas school districts the author does not find evidence of economies of scale. The only significant variables resulting from the regression analysis are a constant term, the number of students per teacher and a dummy variable which indicates that the school district offers elementary education.

6. Hanson, N.W. (1964) "Economy of Scale as a Cost Factor in Financing Public Schools" National Tax Journal 17, 92-95.

In this cross section study of 577 school districts in nine states the author uses two variables. The independent variable is school district size and the dependent variable is a unit cost residual from each state which is obtained by adjusting current expenditures per pupil for the influence of certain characteristics of the adult population on expenditure levels. In six states a U-shaped cost curve results and in the remaining three continuing economies are present. The median optimum size is 50,000 pupils.

7. Hettich, W. (1968) "Equalization Grants, Minimum Standards, and Unit Cost Differences in Education" Yale Economic Essays 8, 5-58.

In the section of this paper dealing with "Efficiency and District Size" the author analyses 1959-60 data from 118 Michigan districts and 124 New York districts. The dependent variable is current expenditure on full-day school per pupil in average daily attendance (ADA). The first three independent variables allow for three different size classes of elementary school while the next three do the same for secondary schools. The remaining independent variables are (a) average teacher salary; (b) number of auxiliary personnel per thousand pupils (ADA); (c) percent ADA in secondary schools; (d) equalized valuation of property per pupil ADA. The results of the study indicate that economies of scale do exist and that they are greater in secondary than in elementary school. The minimum efficient scale in elementary schools appears to be about 300 students while that in the secondary sector is approximately 580 pupils per school.

8. Hirsch, W.Z. (1960) "Determinants of Public Education Expenditures" National Tax Journal 13, 29-40.

In an attempt to explain the determinants of expenditure in the thirty school districts in the St. Louis City - County area the author runs a multiple regression using eight variables. The variables are: (a) average current expenditure plus debt service (the dependent variable); (b) number of pupils in Average Daily Attendance; (c) variable [b] squared; (d) high school pupils as a percent of all pupil's; (e) number of pupils per square mile; (f) percent increase in public school pupils in Average Daily Attendance, 1951-56; (g) average assessed valuation of real property per pupil in Average Daily; (h) index of quality and scope of public education.

Hirsch pools cross section data from two non-coterminus periods 1951-52 and 1954-55 and finds only variables (d), (g) and (h) are statistically significant. Given the statistical insignificance of variables (b) and (c) he concludes that there is an absence of significant economies of scale in the sample area.

9. Michelson, S. (1972) "For the Plaintiffs - Equal School Resource Allocation" Journal of Human Resources 7, 283-306.

As part of his analysis of the Hobsen vs. Hansen case the author critizes Cohn (1968) and Riew (1966). In particular

he calls into question the diversity of their results.

10. Netherlands Central Bureau of Statistics (1965) Statistical Investigations on Education and Leisure (2) - Size and Cost of Secondary Grammar Schools (The Hague).

In this cross section study a regression is run with total cost per annum (excluding investment cost) as the dependent variable and number of pupils as the independent variable.

The data from 330 schools produce an L-shaped average cost curve with the horizontal portion beginning in the range of 500-600 pupils.

11. Osborn, Donald D. (1970) "Economies of Size Associated with Public High Schools" Review of Economics and Statistics 52, 113-115.

This study utilizes 1966 data for the state of Missouri. Current expenditures per pupil is used as the dependent variable. The independent variables are (a) school classification; (b) tax levy; (c) district wealth; (d) median educational attainment; (e) geographical location; (f) size; (g) size squared; (h) teacher salary squared; (i) percent of students in high school. Data from the 433 districts used in the study produce coefficients which suggest the existence of negligible economies of scale in schools.

12. Riew, J. (1966) "Economies of Scale in High School Operation" Review of Economies and Statistics 280-287.

This cross section study concentrates on a sample of senior high schools in Wisconsin. In an attempt to equalize quality the author first accepts into his sample only those schools which are accredited by the North Central Association and then eliminates those schools which have an average teacher salary of more than $6,500.

The relevant cost variable is total cost minus capital outlays, debt service, transport and auxiliary services. The dependent variable is costs, thus defined, divided by average daily attendance. The independent variables are (a) enrolment; (b) average teacher salary; (c) number of credit units offered; (d) average number of courses taught per teacher; (e) change in enrolment between 1957 and 1960; (f) percent of classrooms built after 1950.

15. Wales, T.J. (1972) "The Effect of School and District Size on Education Costs in British Columbia" Department of Economics, University of British Columbia, Discussion Paper No. 83.

The author uses 1969 data to analyse the behaviour of various educational cost components in British Columbia. Costs relating to the conveyance of pupils, auxiliary services are not analysed nor are the non-operating and capital accounts. The author finds that teacher salary costs per pupil drop critically as school size increases but then does not follow any definite pattern. This is true for both elementary and secondary schools.

An analysis of other operating costs (instructional expenses except salaries, operation of school plant, repair and maintenance of school plant) reveals that average cost per pupil initially declines for all categories and only in the case of repair and maintenance do costs eventually rise.

When district administrative costs are considered a declining average cost curve is estimated. The minimum point of the curve occurs at approximately 30,000 pupils.

Impact of School Resources on Student Cognitive Performance Outcomes

SCHOOL INPUT	NUMBER OF STUDIES INDICATING A RELATIONSHIP TO STUDENT COGNITIVE PERFORMANCE		
	Significant Relationship	Somewhat Related	Little, no or Unclear Relationship
District Characteristics			
District size	1		
School size	3		
Student/teacher ratio	7	1	2
Student/professional ratio	1		
% student transfers			1
General expenditure level	4	2	1
School Facilities			
Building condition			2
Science lab facilities	1		1
Building age	2		1
$ makeshift classrooms	1		
Existence of library			1
Library books/student	3		1
Playground space			1
Facilities in general			2
Curriculum, Instruction			
Performing arts programs		1	
Curricular innovations		1	
General curriculum			2
Number of school days	1		
TV, programmed learning		1	
Number of textbooks			1
Age of textbooks			1
Spending for instruction	1		
Teacher Characteristics			
Experience	7	1	2
Degree status	5	1	4
Quality, undergrad inst.	3		
State certification			1
National Tchr. Exam. tests	1		1
Verbal ability	6	1	
Teacher attitudes	2		
Amount of tchr. travel	1		
Age	1		
% time in area of spec.	3		
Time spent in guidance	1		
% male teachers (math)	1		
Starting salary	3		
Average salary	1		
Teacher turnover		2	
Administrative Characteristics			
Principal's education level		1	
Expenditures for administration			1

Source: Advisory Council on Fluctuating School Enrolments (1977, 191).

Additional Bibliography

1. Advisory Council on Fluctuating School Enrolments (1977) The Impact of Fluctuating School Enrolments in Minnesota's Educational System. (Madison)

2. Blake, H. (1954) Class Size: A Summary of Selected Studies in Elementary and Secondary Schools. Unpublished Ph.D. dissertation (Columbia University).

3. Blaug, M. (1970) An Introduction to the Economics of Education (London: Penguin Books).

4. Cohn, E. (1972) The Economies of Education. (Toronto: Lexington)

5. Dancey, K.J. and D.A. Dawson (1973) A Study of Economies of Scale in the Ontario Public School System. An unpublished report submitted to the Ministry of Education of the Government of Ontario.

6. Dawson, D.A. (1969) Economies of Scale in the Secondary Sector in the Province of Ontario. Unpublished Ph.D. dissertation (Department of Economics, University of Western Ontario).

7. Dawson, D.A. (1972) "Educational Quality Indices" The Alberta Journal of Educational Research 18, 35-44.

8. Furno, O.F. and G.J. Collins (1967) Class Size and Pupil Learning (Baltimore: Baltimore City Public Schools).

9. Jencks, C. (1972) "The Coleman Report and the Conventional Wisdom" in D.P. Moynihan and F. Mosteller (eds.), On Equality of Educational Opportunity (New York: Random House).

10. Katzman, M.T. (1968) "Distribution and Production in a Big City Elementary School System" Yale Economic Essays 8, 201-256.

11. Katzman, M.T. (1971) The Political Economy of Urban Schools (Cambridge: Harvard University Press).

12. McDermott, J.E. and S.P. Klein (1974) "The Cost-Quality Debate in School Finance Litigation: Do Dollars Make a Difference" Law and Contemporary Problems 38, 415-435.

13. President's Commission on School Finance (1972) Schools, People and Money: The Need for Educational Reform - Final Report (Washington, U.S. Government Printing Office).

14. Summers, A.A. and B.L. Wolfe (1977) "Do Schools Make a Difference?" The American Economic Review 67, 639-652.

15. Rideout, E.B., J.S. Murray, C. Sylvester and M. Harris (1975) Meeting Problems of Declining Enrolment (Toronto: Ontario Ministry of Education).

16. Rideout, E.B., J.S. Murray, C. Sylvester, M. Harris, L. Shanahan (1977) Educational, Social, and Financial Implications to School Boards of Declining Enrolments (Toronto: Ontario Ministry of Education).

17. Ryan, D.W. and T.B. Greenfield (1975) The Class Size Question (Toronto: The Ontario Institute for Studies in Education).

18. Winkler, D.R. (1972, 1973) "Do Dollars for Higher Quality Teachers Make a Difference" Compact Dec. '72, Jan. '73, 13-19.